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ABSTRACT

A 3-year project to establish a college-level interdisciplinary computer center/scientific laboratory for the social sciences is described. The purpose of the project was to improve education in empirical and behavioral research methods. The center consists of computing facilities, a survey research facility, a simulation/gaming facility, and a resident specialist in quantitative methods. The laboratory is not tied to a specific curriculum but rather operates as a free-standing unit available to all social scientists and students. It contains a variety of software, a library, video recording equipment, calculators, audio centers, and projection equipment. The methods specialist teaches one interdisciplinary course per year and works with students and faculty on various projects. Although student activity in the laboratory includes both independent and course-related work, the most tangible outcomes involve staffing and curricular innovations. Many courses have been modified to include computer instruction and use of the center. Currently, more than 80 percent of all social science majors have used the facilities. The project has been successful in providing students with quantitative instruction. (KC)

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IMPROVEMENT OF SOCIAL SCIENCE EDUCATION VIA THE
DEVELOPMENT OF A SOCIAL SCIENCE LABORATORY

FINAL REPORT

Comprehensive Assistance to Undergraduate Science Education

Grant number SER-78-064891

Beloit College

Project Director: Jerry W. Gustafson

Department of Economics

April 26, 1982

"PERMISSION TO REPRODUCE THIS
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This report provides a narrative description of a three-year plan of activities funded by a grant of \$138,700 from the CAUSE program of the National Science Foundation. A separate evaluation study undertaken by a team of students and outside consultants was completed in the summer of 1981. A copy of that report is attached.

The purpose of the plan of activities was to improve education in the empirical and behavioral aspects of social science methodology. Beloit faculty had determined that institutional strengths in the theoretical and critical traditions of social science were not matched by high quality teaching and application of modern tools of quantitative and behavioral analysis. Students needed more encouragement to think probabilistically as well as deterministically about social behavior, to address problems in a framework of hypothesis formation and testing, to acquire skills in data analysis and modeling, and to engage in research which would apply classroom abstractions. Faculty set a general goal of increasing study time of social science students devoted to acquisition and practice of quantitative and behavioral techniques from less than 10% to at least 20%.

The strategy selected was to construct a multipurpose laboratory containing a variety of resources necessary for learning empirical techniques and conducting research in the disciplines of Anthropology, Economics, Government, Psychology and Sociology. The resources included computing facilities, a survey research facility, a simulation/gaming facility for observing and recording social interaction in various controlled settings, and a resident specialist in quantitative methods. This laboratory was to provide a catalyst to encourage existing faculty to upgrade methodological skills, to introduce additional quantitative instruction into the curriculum, and to undertake modest research projects with student teams. Such activity had been seriously restricted by inadequate access to computational equipment, data resources, and expert guidance necessary for those faculty whose methodological skills had grown rusty.

While these laboratory resources were to facilitate and encourage the learning and application of quantitative techniques, they were not rigidly tied to anticipation of specific curricular development. Faculty intended the lab to be a free-standing unit available to serve all social scientists as their particular needs arose. It was attractively designed to encourage frequent visitation by students and to provide maximum opportunity for self-tuition. It was to provide an interdisciplinary focus for participating departments and to draw the meager resources of individual departments into a more productive critical-mass at the divisional level where interdepartmental spill-over benefits could become manifest.

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We believe this strategy proved sound and could serve as a useful model for other small colleges.

The Social Science Laboratory

Approximately \$60,000 was allocated to construction of the physical facility, equipment, software, and data archives. Following visits by Beloit faculty to laboratory resources at the Universities of California-Santa Barbara, South Carolina, Connecticut, Michigan, and other sites, we proceeded to adapt others' ideas to appropriate Beloit scale.

An area of approximately 2000 square feet in the main social science building was allocated to the laboratory project. The major portion of this space is divided into three adjacent and connecting rooms, each having a common width of 20 feet and varying in length from 18 feet to 30 feet. One room contains computational equipment for data analysis. It is adjoined by offices for student lab staff and for the social science methods specialist. The other two rooms serve as a simulation lab. They are outfitted with operable wall which permit them to be divided into as many as six small conference rooms. The centermost of these is equipped as an observation/monitoring area with one-way windows overseeing each of the conference rooms. The perimeter of the simulation area is rimmed with fourteen individual carrels, each equipped with telephone and electrical service.

Three other offices are across the corridor from the main laboratory space. One of these is soundproofed and is outfitted as a psychological perception lab. The others serve as offices for faculty and students involved in ongoing research and for game control.

Equipment and Resources

The data analysis room contains two terminals to the College's H-P 3000 mini-computer. It also contains six Commodore micro-computers supported by two dual floppy disk drives and two dot-matrix printers. A wide variety of software, documentation, machine manuals, etc., are available on site. The micros are ideal for teaching of BASIC, performing statistical chores (with a statistics package adapted from an AppleSoft subset of P-Stat developed by Gary Grandon, formerly of the Roper Center) and word processing. Larger data sets may be processed on the H-P 3000 by SPSS, by an interactive cross-tabulation package called VOTER, developed by project consultant Dr. Bruce Bowen, or by other packages.

Institutional memberships in the InterUniversity Consortium for Political and Social Research and in the International Survey Library Association of the Roper Center provide access to an extremely wide variety of research and public opinion data as well as to the smaller teaching data sets developed by ICPSR for political science SET-UPS modules.

A small library of instructional manuals, code books, computing magazines, game packages, and other documentary material is available on site.

The gaming area is equipped with a sound system to provide direct communication between observation and conference rooms; video recording capability for observation of simulation activity, playing of instructional tapes, etc.; a telephone bank, used for training in survey interviewing, conduct of surveys, and as a mode of communication during gaming; and a variety of calculators, audio recorders, and projection equipment commonly used in social science research and teaching.

Faculty Resources

A social science quantitative methods specialist has been employed with regular faculty rank. Since this position serves all five participating departments, it has been located in a non-departmental category under the title of "Professor of Behavioral and Social Science." Dr. Allen Russell, a quantitative political scientist, has filled this novel position. Dr. Russell's classroom teaching has been limited to one interdisciplinary applied quantitative methods course per year. The course focuses upon survey research techniques and use of computer packages. It nicely complements several departmentally-based methods courses which tend to focus more narrowly on techniques specifically geared to the particular discipline.

Most of his teaching has been of a non-classroom variety. He has worked with students both individually and in groups, aiding in a variety of problems of research design, machine use, and so on. In his close work with student lab staff, he has created a cadre of especially competent students capable of teaching and guiding their peers.

He has also worked closely with faculty on an extremely wide variety of projects of their choosing. These range from research design, estimating grant proposal costs, help with statistical and computer problems, use of games in the classroom, locating and obtaining necessary data sets, to consulting about curricular change. Equally important, he has served as a valuable catalyst, encouraging many faculty to engage in programs of professional development and curricular change in which they had interest but considerable hesitancy.

This unusual faculty position has been responsible for much of the success of the overall project. It has provided the continuous thrust which is often lacking in projects where most participants are distracted by the press of non-project related concerns. We recommend such a position to other small colleges—at least where interdepartmental relations permit an easy sharing of common resources.

Intermediate Impact

The process of implementing the laboratory did stimulate faculty and student interest in quantitative and behavioral analysis which was immediate, substantial, and which has grown steadily.

Seven social science faculty made site visits to nine laboratory and computing facilities at other institutions. Six expert consultants visited Beloit during the developmental stage of the lab and each spoke to a number of social science faculty about how they might prepare to use the facility. Eight faculty undertook programs of developing quantitative and computer skills, developing simulations for classroom use, preparing computer exercises for existing courses, and other desired activity. Seven faculty conducted a total of ten modest research projects which drew upon laboratory resources. Each of these employed between one and three students as project assistants.

In sum, 75% (fifteen of twenty) social science faculty participated in depth in developing the facility, preparing for its use, or in engaging in empirically oriented research. Additionally, three natural science faculty used the facility during two summer institutes for high school science teachers on use of computers in secondary level science education. (This program, though funded by NSF, was independent of the CAUSE grant.) In total, the laboratory, although designed for social science use, attracted the involvement of 46% of the entire Beloit science faculty.

Such wide involvement markedly enhanced the attention given and importance assigned to quantitative aspects of the disciplines. Indeed, the wide and growing interest in computer-related activity provided a convincing rationale for the College to upgrade its computing center. The installation of an H-P 3000 with (originally) eight remote terminals provided substantial unanticipated spill-over benefits to the social science laboratory project.

Students were as eager to become involved in lab activities as faculty. Approximately 10 students per term, and some 30 in all over the grant period, were employed as laboratory aids. Most of these had little or no computer or statistical skills at the time of their employment. The majority of these quickly learned the fundamentals of machine operation and the BASIC language and were able to give valuable assistance to their fellow students. The staff-aids, drawn from a wide range of departments, also provided the nucleus of a supportive culture and esprit.

As the laboratory approached completion, student use grew rapidly. Even before the official opening in March, 1981, between two and three hundred individual students per month were visiting the facility with some regularity. Many of these were casual users involved in use of computer games, rudimentary instruction in BASIC, and general study. Even so, most of these developed feelings of comfort with the equipment and the beginnings of computer literacy. And many students came to pursue serious tasks and made good progress. Dozens of students found they could use canned statistics packages, particularly regression routines, to support their independent research for papers assigned in their courses. Many found they could learn BASIC with little guidance and wrote programs tailored to their own needs.

Several student teams undertook research projects of their own for public delivery at our student research symposium. A team of anthropologists performed an analysis of current student opinion using their own cross-tabs program to process the survey data. A political science major teamed with an economics major to perform a pre-election study of the Rock County 1980 Presidential race. An economics major gathered a group of student subjects to participate in several experiments in social choice for which she utilized the games laboratory.

While such activities demonstrated that students could learn a great deal on their own if provided a conducive environment, those students who engaged in course work or research which called upon specific use of the laboratory facilities made the most substantial and impressive gains. The new interdisciplinary applied statistics course has had perhaps the greatest impact. The coupling of instruction in a wide variety of statistical techniques with the simultaneous teaching of packages such as SPSS has been a notable success. The majority of twenty or so social science students who have enrolled each year have developed a competence in data processing and interpretation of results which exceeds that of virtually any pre-grant Beloit student. The evidence, though still incomplete, suggests that the instruction in statistical concepts and machine use are mutually reinforcing. (Limited evidence also suggests that students having substantial casual exposure to the laboratory environment before enrolling in any quantitatively oriented course tend to do better than those who have not.)

Several other courses have stimulated student work in quantitative and behavioral issues. An anthropology professor has begun to teach the basic math statistics utilizing examples and illustrations oriented toward anthropological research and uses the lab for assigned exercises. A psychology professor supervised a student team who converted a set of programs obtained from CONDUIT which simulate a variety of experiments in cognition and perception. Each student now runs through these experiments as a laboratory component in the course on perception. A government professor has videotaped network election coverage and calls upon students in American government to view and closely analyze the impact of various techniques of coverage. Another government professor has developed modules for his international relations courses for running games such as Guetzkow's "International Simulation" and a defense budgeting

game which he has written. Mr. Russell has trained more than a dozen students in survey research and has, with their assistance, conducted a variety of surveys including a Presidential Primary study, a post-election Presidential study, a needs assessment for a local health agency, and a market study for a local library.

Various other faculty led research projects have called upon many students to perform specific tasks related to quantitative and behavioral issues. Topics have included language development in infants, social characteristics of the Kru people of Liberia, attitudes of litigants in medical malpractice suits, patterns of preference equalization in international trade, an evaluation study of the social science laboratory, and various regression studies of macroeconomic data.

While this work has been generally good, we would make no special claims about its quality. What is important is the recognition that the presence of the laboratory did, indeed, stimulate a considerable variety of activity and attention to modern methods of social analysis. The activity simply would not have occurred without the laboratory facility.

1. Institutional Changes

The most tangible outcomes are indicated by staffing and curricular modifications and innovations. Perhaps the most significant result, which suggests the faculty's valuation of the project, is marked by the College's commitment to continue the position of social science methods specialist during the post-grant period. In the view of participating faculty, this position has so increased the productivity of the social science departments, and has contributed so greatly to the direct education of students in methods, that it is essential to continuing program.

Professor Russell has introduced a new course into the curriculum, as has been previously mentioned: Behavioral and Social Science 200. The course is an applied quantitative methods course which focuses on teaching use of computer statistical packages. Furthermore, in the interest of achieving greater efficiency than is possible with tutorial techniques, he has begun to teach a group of five one-half unit courses oriented to the most popular lab uses. These include "Microcomputer Use and the BASIC Language," "Studying Society Through Games and Simulation," "Exploratory Data Analysis" (an elementary presentation of the highly intuitive and inductive approach toward numerical data pioneered by Tukey and others), "Computer Simulation of Human Behavior," and "Introduction to Use of Statistical Computing Packages" (which will be spun-off the BSS 200 course and enlarged to incorporate instruction in the interactive P-Stat package and a microcomputer package as well as SPSS and Voter.)

We believe these new courses, together with modifications described below will complete our attempt to provide Beloit students with the opportunity for breadth and depth in quantitative orientation desirable at the undergraduate level.

Courses modified as a result of the grant include the following: An anthropologist has developed a section of Math 106, Introduction to Statistics, to employ examples from anthropology, archaeology, and other social sciences. He also has developed computer simulation of an archaeology site and various quantitative exercises for use in his other courses. He has also written a program for computer instruction in the Quechua language which is used in the "Topics in Anthropology Course." Economics 206, Macroeconomic Theory, now includes a requirement of a major paper of empirical orientation. The focus of this paper is upon application of regression analysis. Economics 301, Econometrics, and Economics 115, Statistical Analysis for Business, have been modified to emphasize time series analysis so as to complement the BSS 200 course. Economics 315, Management and Organization now includes several so-

cial science games. Introduction of empirically oriented segments are contemplated for courses in Public Sector Economics and Managerial Economics. A decision has been reached to fill an opening in the department with an applied quantitative person whose specific interests would entail fostering quantitative research opportunities for students.

In Government, courses in International Relations and International Politics now each contain instructional simulations as components. The course in Urban Government also includes games such as the "Urban Simulation." American Government includes close observation of media election coverage and utilizes our videotaping equipment for that purpose. Empirical modules utilizing various "set-ups" packages are slated for inclusion in American Government and International Relations.

The Psychology Department has upgraded quantitative education in a variety of courses since both current full time members are empirically oriented. The most significant change is the laboratory component of Psychological Perception which includes computer simulated experiments in psychophysics. The psychology perception lab, equipped with soundproofing and Commodore 8032, is a permanent fixture of that department's program.

In Sociology, the methods course has been reoriented to give greater emphasis to statistical analysis following the participation of the professor in an ICPSR Summer Institute on data analysis.

Curricular changes have clearly been extensive.

2. Impact upon Students

Since the social science laboratory was designed as a multipurpose resource to be shared by five departments, and not tied to particular courses of instructional study, and since much educational enterprise was designed to be self-tutorial, it was difficult to keep records of precisely who was "receiving instruction" under the project. Since all students receiving explicit instruction in courses or applied research were also lab visitors, it seems best to draw conclusions primarily on the basis of daily logs which were maintained to monitor visitation during the grant period.

Each student who entered the lab was asked to sign a log sheet and to enter the purpose of the visit, the time and the student's major. There are numerous problems with relying too heavily upon information accumulated from such logs. Many signatures are illegible, many persons failed to sign in, many had not as yet declared their major. Students often would enter general terms as "purpose of visit" such as "class" or "study" when they indeed spent time on the computers, viewing videotapes, browsing through library materials, or in conversation. The level of seriousness of purpose in such visits naturally varied enormously.

Nevertheless, the log sheets verify faculty impressions that the percentage of students enrolled in social science courses who employed lab services was impressively large. A fairly close analysis of several months of lab visitation is included in the attached evaluation study. As a summary, the following table would seem to be tolerably accurate:

STUDENT USE OF LABORATORY

Percentage of Total Number

Year	Total # of Students	Science * Majors	Non-Science Majors	Women	Minor- ities	Handi- capped	Adult† Students	Prospective Teachers
78-79	5	100	—	2	—	—	—	—
79-80	105	95	5	30	2	—	12	4
80-81	235	90	10	35	3	—	14	12
81-82	260	90	10	35	3	—	0	12
Total	605							

* includes undeclared but likely science majors

† includes NSF summer science teachers institute

The students involved in the laboratory and related activities constitute more than 25% of the entire student body. Approximately 80% of all social science majors and 10% of natural science majors have used the facilities and have received instruction under the grant.

The extensive changes in student attitudes toward quantitative work and skills in application of them are obvious to faculty. Students already take the laboratory rather for granted. It seems far more natural to them to be assigned quantitative tasks than was formerly the case. There is a growing culture among frequent lab users which is more professional and serious in orientation than was formerly the case. Although we are far from finished with the task of working the lab into the total educational experience of students, there are, nonetheless, large numbers of students learning computing and statistics, participating in surveys, running SPSS, and engaged in other aspects of empirical and behavioral work. Skyrocketing enrollments in introductory computer science and statistics have partially been the result of the opportunities the lab offers. Since virtually none of this activity was going on three years ago, we think we have made impressive progress.

Evaluation

One of the novel aspects of the grant was the employment of a team of student participants as evaluators of the project. Six students worked under the direction of an outside consultant, Prof. Jeffrey Miller of Lawrence University. Dr. Miller called three other evaluation researchers as additional consultants in this project. This group of outsiders, coordinated by the Project Director, made a total of nine visits, mostly of two days, during the spring, 1981, semester. They provided the team with a workshop in evaluation research and had them apply their learning to an evaluation study of the laboratory itself.

Although the students were naturally hampered by lack of measurement of outcomes, they found that lab use had been extensive, that students and faculty alike widely shared the opinion that it was a valuable, even essential, addition to Beloit program, and that students were indeed growing increasingly comfortable with and proficient in quantitative techniques. Although the report may fall short of high professionalism, it was of considerable value to lab administration. The students reported great satisfaction with what they had learned from being permitted to participate in the evaluation. A copy of the final report is attached.

Conclusion

The original grant proposal and budget were followed nearly to the letter. The program of activities achieved substantial success in improving the Beloit educational environment where it was weakest.

Submitted by
Jerry Gustafson
Project Director

Attachment 1
Faculty Participants in the Project

Anthropology

Professor Daniel Shea
Professor Lawrence Breitborde

Economics

Professor Jerry Gustafson
Professor Emil Kreider
Professor Lester McAllister
Professor James Ozuello

Government

Professor Milton Feder
Professor Warner Mills

Psychology

Professor Geoffrey Magnus
Professor Roland Reboussin
Professor Allen Raffetto
Professor Debra Poole

Sociology

Professor Menno Froese
Professor Marlynn May

Social and Behavioral Science

Professor Allen Russell

NSF Science Teachers Summer Institute Staff

Professor John Jungck
Professor Paul Campbell

Attachment 2
Project Consultants

1. Laboratory development and implementation

Dr. John Stucker, Professor of Political Science and Director of the Social and Behavioral Science Laboratory, University of South Carolina
Dr. James Davis, Professor of Sociology, Harvard University
Dr. Gregory Marks, Director of Computer Support, Inter-University Consortium for Social and Political Research
Dr. Fred Goodman, Professor, College of Education, University of Michigan
Dr. Bruce Bowen, Corporate Economist, Blue Cross of Northern California
Dr. Gary Grandon, Assistant Director for Computer Services, The Roper Center
Dr. Gordon Stephenson, Animal Behavior Laboratory, University of Wisconsin-Madison

2. Computer Resources

Karl Matzke, President, Madison Computer Store
William Hinrichs, Professor of Mathematics, Rock Valley College

3. Evaluation

Dr. Jeffrey Miller, Prof. of Political Science and Director of Public Policy Program, Lawrence University
Dr. Robert Haverman, Prof. of Economics, University of Wisconsin-Madison
Dr. William Gormley, Prof. of Political Science, University of Wisconsin-Madison
Dr. James Davis, Prof. of Sociology, Harvard University